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Rachel M. Bush
North Dakota State University

Mark E. Clark
North Dakota State University

Wendy L. Reed
North Dakota State Univerisity, wendy.reed@ndsu.edu

George M. Linz
USDA/APHIS/WS National Wildlife Research Center, george_m_linz@yahoo.com

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NSA Contact Information

National Sunflower Association
4023 State Street
Bismarck, ND 58503-0690
(701) 328-5100
(888) 718-7033

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Rachel M. Bush[1]
Mark E. Clark[1]
Wendy L. Reed[1]
George M. Linz[2]

1. Department of Biological Sciences, NDSU, Fargo, ND
2. USDA/ APHIS/ WS National Wildlife Research Center, Bismarck, ND

INTRODUCTION

Many of the suggested management techniques directed at reducing blackbird breeding populations fail to incorporate the underlying mechanisms regulating populations. Theoretically, removal of individuals from the breeding population should lower the breeding densities and presumably reduce recruitment. However, compensatory responses might occur with decreased breeding densities, but no empirical data are available to test this hypothesis. Much of the underlying compensatory theory is based on differential allocation of resources to reproduction vs. self maintenance at different breeding densities, mainly in the form of depensatory effects of resource limitation on growth and survival. However, as the breeding density in an area changes, social interactions among individuals also change (Whittingham and Schwabl 2002; Pilz and Smith 2004). Recent research has shown maternally derived steroid hormones present in eggs offer a potential compensatory mechanism by which adult social interactions affect offspring growth and survival (Schwabl 1996a; Schwabl 1996b). Gaining insight into the underlying mechanisms regulating red-winged blackbird populations will allow for more effective and efficient management techniques. This study focuses on the effects of density and social interactions on Red-winged Blackbird reproduction, and the associated underlying mechanisms.

METHODS

Our study sites were located within the Prairie Pothole Region of North Dakota in Stutsman and Towner Counties. We conducted nest searches beginning 1 May 2004 through 30 June 2004 and 7 May through 30 June 2005. In order to experimentally test the effects of increased density on reproductive parameters, we randomly assigned nests to one of the following 3 groups: (1) Treatment

females, which were exposed to a simulated increase in density by presenting a caged conspecific; (2) Control females, which were exposed to an empty cage; and (3) Super Control females, which received no presentations. Presentations were conducted 4 times per day, for a length of 30 minutes per presentation. During presentations, behavioral observations were taken of the focal female to assess overall aggressive behavior. Behavioral observations were not conducted on Super Control groups. Presentations were conducted until the number 2 egg was laid, in order to ensure the effects of simulated increases in density affected yolk steroid allocation. We collected the number 2 egg to analyze for maternal yolk steroid concentrations by radioimmunoassay. Once presentations were concluded, monitoring of nests continued to obtain an overall record of reproductive performance (i.e., final clutch size, number hatched, number fledged). Prior to offspring fledging, each nestling was individually marked with aluminum USFWS bands and 3 color bands. In 2004, adult females were captured prior to offspring fledging and fitted with radio-transmitters. Females were then monitored in order to obtain date of independence of offspring, as well as mark-recapture estimates of fledgling survival. In 2005, we attached radio-transmitter to nestling Red-winged Blackbirds to estimate survival.

RESULTS

In 2004, overall nest success was 18.1%, and in 2005 overall nest success was 63.6%. For 2004 and 2005 we found no significant difference in nest success among the treatment groups. Mean clutch size was 3.38 (n=68, se= 0.10) for 2004 and 2005. We found aggressive ranks were significantly higher in treatment females than control females in both years. However, we found no difference in total androgen levels allocated to yolks among the three treatment groups. Androgen levels did not differ between years. We report inter-assay variation as 27.2% and intra-assay variation as 16.5%.

DISCUSSION

We examined the effects of increased nesting density on androgen levels in the eggs of Red-winged Blackbirds in an attempt to understand underlying mechanisms controlling populations. Red-winged Blackbirds are considered by some to be semi-colonial, and this life-history trait may

be important when considering we found no significant differences in androgen levels among the treatment groups. In previous research Whittingham and Schwabl (2002) found positive correlations between the number of female-female interactions and yolk testosterone levels, however their work was conducted on the solitary nesting tree swallow. In many species maternal androgens have been found to have positive affects on offspring, and are thought to be allocated by the female to infer some advantage to the offspring. In cases of solitary nesting species, an increase in nesting density may be physiologically stressful to the female, and consequently androgens are passed onto the egg. However, Red-winged Blackbirds normally experience high nesting densities in much on the northern Great Plains, and may not be physiologically stressed by increased densities. Further research is needed to determine if the hormone levels of nesting females are altered with a simulated increase in density. We know the behavior of treatment females was significantly affected, however, no differences in nest success among the groups were found.

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